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Exceptional Rain in the Libyan Desert

By L. J. Sutton, M.A., F.Inst.P.

On December 28th-30th, 1930, rainstorms of remarkable severity occurred in the Libyan desert of Egypt, and in particular near the Mediterranean Coast of the Western Desert Province. The region of heavy rainfall extended into the desert at least as far as the Oasis of Siwa, 250 kilometres inland, while there was during the same period very heavy rain from southern Greece across the Mediterranean to Africa. The rain which fell in Egypt was associated with two depressions each of which had a well-marked cold front. In the morning of the 28th a deep depression was situated over Crete and a shallow one in the Libyan Desert near Siwa Oasis. The latter depression travelled in an easterly direction over middle Egypt, the trough passing Cairo at 4 a.m. on the 29th. The former moved south to the Egyptian coast, deepened considerably on the 29th, and turned north-east to Cyprus, the trough passing the meridian of Cairo at 3 a.m. on the 30th.

A rain gauge was first installed at Siwa Oasis about the end of 1919. Although rain is by no means of rare occurrence in the winter and spring it is usually very light so far in the interior of the desert. In the eleven years over which records extend there were 93 occasions on which rain was noted, but these include 63 occasions when the amount was less than a tenth of a millimetre. Throughout 1923 there was an entire absence of

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rain. Until last December the largest fall in a single day during the past eleven years was 10 mm., and the largest amount for any year slightly under 20 mm.

On December 28th, 1930, light rain began to fall at 8 a.m. It became heavier at noon, accompanied by thunder and lightning, and continued heavy until 8 p.m. There was precipitation until 2 a.m. on the following day. In the 24 hours ending 8 a.m. on the 29th the amount registered was 28 mm. A strong south-west wind blew nearly all day on the 29th, and a further rainfall of 7 mm. was registered. Siwa lies in a large depression 25 metres below sea level. The water in the lakes is salty and nearly all the wells are brackish. As a result of the storm about ninety houses which were built of mud bricks containing a considerable amount of salt were destroyed. At Sollum on the coast, on the frontier of Egypt and Tripoli, the course of the storm was similar, rain falling incessantly from 8 a.m. on the 28th to 4 a.m. the next day, when strong winds arose and blew off some of the roofs of the houses. The rainfall amounted to 37 mm., and owing to the wind and rain most of the houses received damage. The storm was most severe at Mersa Matruh, on the coast almost halfway between Sollum and Alexandria, the rainfall there being of intensity phenomenal in Egypt. Between 8 a.m. and 8 p.m. on the 28th 35 mm. were recorded, and in the next twelve hours an additional 64 mm. fell. There was then a fine interval until the afternoon, when it again began to rain heavily, and 21 mm. fell by 8 a.m. on the following day. At Ras el Dabaa on the coast halfway between Matruh and Alexandria, 40 mm. fell on the 29th.

The extent and severity of this rainfall are quite extraordinary. The amount of 99 mm. at Matruh constitutes with one exception (see later) the largest fall for a single rain day at any station in Egypt for which records exist.

Observations of rainfall have been made at Matruh for 25 years, and this station previously held the record for Egypt, with 77mm. on December 12th, 1923, for the highest rainfall in one day. It was, however, followed closely by Sidi Barrani, 130 kilometres to the west, with 76 mm., and Borollos Lighthouse, the most northerly point of the Delta, and Faqus, near the eastern boundary of the Delta, 50 kilometres west-north-west of Ismailia, with 75 mm. These amounts are very large, when it is considered that the normal rainfall at Alexandria, the rainiest place in Egypt as far as is known, is only slightly more than 200 mm. for the whole year. At Matruh the normal yearly rainfall is 165 mm., but in 1908 rainfall amounted to 383 mm. and in 1930 to 380 mm. In the coastal strip there are a number of Bedouin tribes which subsist chiefly by cultivating patches of rain-grown barley sufficient to support them, while the short grass and herbage which spring up after rains provide sub-

sistence for their camels, sheep and goats. On the rainfall, small as it is, they depend almost entirely for their existence, and late rains are particularly welcome.

At Alexandria the largest rainfall in any year since 1869 is 326 mm. in 1897. With the exception that for December 9th, 1888 (it is noted that a waterspout occurred in the neighbourhood on that day) an amount of 279.9 mm. appears in the records, the largest fall there on any single day in the last 47 years, is only 55 mm.—on December 20th, 1914. The largest day's rainfall in Cairo since 1887 is 43 mm., but steady precipitation lasting practically continuously for 36 hours on December 8th and 9th, 1921, gave 52 mm. of rain.

It may here be mentioned that drainage of storm water in Cairo is a lengthy and difficult operation owing to the flatness of the land. Apart from damage to houses, many of which in the native quarters are built of mud bricks, serious inconvenience and heavy expense are caused by the sand which is washed down from the neighbouring desert by sudden severe storms. A single storm (45 mm.) in 1919, for example, flooded the electric railway between Cairo and its suburb Heliopolis, and caused the suspension of the service for a fortnight. After the storm 40,000 tons of water had to be pumped out of the railway cutting at Qubbah, a few kilometres from Cairo, and when this was done there remained to be removed twenty thousand tons of sand, which had been washed down from the adjacent desert. In May, 1923, a storm (25 mm.) lasting only an hour, deposited in the cutting about the same amount of water, and ten thousand tons of sand.

Experiences of a Meteorological Observer at T'ung Ch'uan, Szch'uan, West China

In 1912, at the suggestion of a friend, I began to send reports of the weather conditions to the Meteorological Office, London. I found it a most interesting study (though it was only temperature and rain), being altogether different from England. On my return from furlough in December, 1916, I brought back a hygrometer and aneroid barometer, and had the regulation screen for the thermometers, &c., standing on one side of the lawn facing north-east. The atmosphere was clear, no smoke and no high buildings, the Chinese homes being more like huts, only ground-floor and roof-in places open to the heavens—hills and mountains all around one—the altitude 1,200ft. above sea-level.

I took my observations at 8 a.m. and 8 p.m. or as near as possible, as sometimes I was busy in the hospital. At times when there was no wind perceptible I used my handkerchief to find the

direction, but often it would remain limp, and the sky be clear blue with a few cirrus and light cumulus floating. Other times, some breeze and heavy nimbus would be seen, then again, heavy storm-clouds or a dust-storm. The last-mentioned was a great trial, everything would be covered with a coating of thin dust, though it was not perceptible to the naked eye. The sunrises were at times very beautiful, especially when travelling on the road, for we started at daybreak, and it was a glorious sight to see the beautiful pink cloud in the east, and the golden orb appearing through it; the dewdrops on grass, trees, plants, hills, sparkling and glistening; the birds waking into song, and rising into the air. Truly, the beauty of nature was there in those early morning hours. Sometimes there would be mist and the sun would make his power felt, and you would see the mist gradually rise and disappear, leaving a sky of deep blue. During the hot summer days there was often not a cloud in the sky.

What impressed me most were the glorious banks of pinky-red cumulus cloud with the blue sky. The former were always more glorious when thunder was about. Many evenings I have stood on the open plain, in the garden, or on the verandah of my study-bedroom, and watched the sheet-lightning playing around the hills; then, a distant roll reverberating round the hills, and, silence again, only the sheet-lightning playing. At other times the sky would darken, and the storm draw nearer, till only the lightning gave light, for in that part of China there was no artificial lighting. It is not easy to describe the grandeur of it all; and, perhaps ten minutes later, drenching rain and blackness—rain came in sheets at times, lightning incessant, and thunder crashing. Storms sometimes occurred in the winter months, but did not last long, nor was there the grandeur.

There was one thing I was thankful for, and that was the cooler nights than in many places during the summer months. There was no twilight, darkness was on you very quickly. Some sunsets were very glorious, others stormy, with great purple-looking clouds. The barometer was low compared with this country, not much above 29·50in. as far as I remember now. The moonlight effects were often very beautiful though cold, but, it was weird travelling by it, for if there is a moon, the Chinese rarely carry a lantern. When called for illness it was really pleasant to have the moon and not to have to trouble with lanterns. The open sky, the fields of corn or rape, &c., the absolute silence of all around; the closed cities with their high walls and locked gates that you crept round, the silent coolies, the lapping of water when crossing rivers; not a sound except, maybe, an insect or a cicada grating. On one went at a steady pace till dawn broke, and you saw the earth clothed in a mantle of dew, and the sun just peeping. Perhaps nearing a city you saw the gates being opened and coolies pouring out to market with their loads of vegetables, &c.

The winter was pleasant, hoar frost and rime were beautiful. I remember seeing snow only once and that was in Chengtu, the capital of Szch'uan. It was a glorious morning, and one awoke to see the earth covered with a pure white mantle, sun just rising, hardly a cloud in the sky; trees, grass, plants, houses, &c., all white. Then as the sun rose higher and made his power felt, a steady drip, drip, and very soon all the beauty gone—just a thing of the past.

Wind was terrible at times, it seemed to roll up from the valleys as the waves of the ocean roll in, and burst with pent-up fury, and then at other times, a gentle breeze. Sand or dust-storms were perhaps the most trying. Fortunately, they did not last long, but everything would be covered with a fine dust; it got in your eyes, your mouth, ears, &c. Rain-clouds were at times striking, because scattered, and often would blow away without any rain falling.

In Suining, a city of lesser altitude, I remember one thunder-storm of about three-quarter of an hour's duration, when the compound was flooded to a depth of two feet, and to get to hospital one had to be carried in Sedan chairs. Rain like that can do a lot of damage to homes built of mud and straw, where there are only tiles overhead—many a home was washed away at that time. This was not in T'ung Ch'uan, but in a city two days' journey away, and we were outside the city walls. At times like that the river rises rapidly, and as huts are built near the bank they are often washed away before anyone has time to try and save anything.

At T'ung Ch'uan I remember one time very clearly. It was a very dark night in the early summer, and, while sitting preparing some Chinese lessons for the next day, I with others, heard cries of "Help," "Chiu min," in English, "Save life." We got up on to the city wall between East and South Gates and looked over. All we could see was water creeping up; people climbing trees calling for help. The river had suddenly risen and was creeping across the fields. It reached the moat outside the city wall, filled it, and crept under the East Gate, although all the gates had been closed at dusk. All the huts under the wall were washed away; people and children were drowned, crops spoiled, &c. It stopped rising about 10 p.m. Next morning it was a pitiable sight, trees rooted up, coffins, furniture, &c., lying in the water, which had receded quite a bit during the night, and mud was left. The Chinese looked on it as fate, but it was very sad to think of so many lives and homes being lost.

The river is a tributary of the mighty Yangtze, which takes its toll of human life yearly. The South Gate was about half a mile from the river; the East Gate a little nearer.

AMY S. MARRS

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, February 18th, at 49, Cromwell Road, South Kensington, Mr. R. G. K. Lempfert, M.A., F.Inst.P., President, in the Chair.

Leonard J. Sutton, M.A.—Note on Haboobs.

This note is a revision and extension of a paper which appeared in the Society's Journal in 1925 on the subject of haboobs—severe dust storms—which occur in the north and central Sudan, chiefly during the rainy season. The statistics, which are drawn mainly from the records of Khartoum, include frequency of occurrence, direction, diurnal variation and average velocity. Examples are given of four representative haboobs, with some photographs and autographic records for Khartoum. Most of the haboobs appear to be due to a current of relatively cold air undercutting warm air, probably in many cases connected with the diurnal variation of temperature which in the summer causes a depression to form during the daytime over the hot arid region between Khartoum and the Nubian Desert.

Prof. S. Chapman, F.R.S. and Miss M. Hardman, M.Sc.—The lunar atmospheric tide at Ocean Island.

The lunar atmospheric tide at Ocean Island, in the Pacific, has been determined from hourly data extending, with gaps, from 1904 to 1912, or the equivalent of about five years continuous data. The annual mean semi-amplitude of the tide is found to be 71 microbars, and maximum pressure occurs at about 20 minutes after lunar transit.

A. C. Best, B.Sc.—Horizontal temperature differences over small distances.

The temperature differences over two intervals of 25ft. and 50ft. at a height of 4ft. above the ground were recorded for nearly three months. It was found that during the daytime the air was not homogeneous. The temperature fluctuated rapidly at any one spot, the amplitude being as much as 1·5°F. under conditions of low wind velocity. This non-homogeneity decreased as the wind increased. There is some evidence that the state of the sky also affects the amplitude of the temperature fluctuations

At night the fluctuations became much slower and temperature differences up to 1·5°F. persisted for periods up to 30 minutes, usually under conditions of low wind velocity. The daytime periods and the night periods were usually connected by a short period of one or two hours when the air at 4ft. was very homogeneous with regard to temperature.

E. Ll. Davies, M.Sc.—A portable temperature gradient indicator

This paper deals with the design and development of a simple portable vertical temperature gradient indicator. The method consists essentially of measuring the differences in resistance of two platinum elements exposed at different heights above the

ground. The advantages and disadvantages of three types of housing for resistance elements are given in detail. With the electrically aspirated housing and a good galvanometer (sensitivity about 2mm. of scale per microampère), differences of temperature to within 0·1°F. are measurable.

Correspondence

To the Editor, *The Meteorological Magazine.*

Frost and strong winds

I was surprised this morning to find a small patch of ice about a square foot in area on a paving stone in my garden at about 9.25 a.m. G.M.T. There had been a high wind all night and it was still blowing fresh at the time. The air temperature was 39°F. at a height of about 4 ft. above the ground. The preceding evening temperatures had been about 45°F. generally in the London area and had fallen during the night to 36° or 37°F. at most stations. The fall was gradual though not regular. At 1 a.m. Croydon's temperature was still 41°F. Exceptionally a minimum in the screen of 31°F. was recorded at Hampstead, of 29°F. at Harrow, and of 32°F. at Rickmansworth.

I was inclined at first to attribute the persistence of the ice to a low wet bulb temperature. I find, however, from an examination of the records from other places that the wet bulb temperature was almost certainly between 34° and 35°F. and the dew point about 26° or 27°F.

The presence and persistence of the ice could not therefore have been due to the low wet bulb temperature alone. There must have been still an appreciable balance of outward radiation from the stone equivalent to the heat convected to the surface of the ice from the air. There was no question of a layer of cold air forming and remaining stagnant on the top of the ice; the stone is in a situation much too exposed for that.

It is so frequently assumed, and in most cases rightly assumed, that the existence of a strong wind during the night will prevent frost, that the occurrence this morning seemed to me to be worthy of note. The dryness of the air was naturally a very important contributory factor. That dryness is in itself remarkable in view of the fact that the air which arrived here during the night had travelled more than 1,000 miles over the sea before it reached our western coasts.

E. Gold.

8, *Hurst Close, Bigwood Road, N.W.*11. *February* 12*th*, 1931.

Circumzenithal Arc

A circumzenithal arc was seen here this morning soon after 10 o'clock, the colours being very vivid. There was a very faint

halo of 22° with an upper arc of contact, the area of contact being very bright, and there was a very bright mock sun to the west of the sun for a short time, but no other halo phenomena. The circumzenithal arc disappeared remarkably suddenly; it was as bright at 10.30 as it had previously been, but one, or perhaps two, minutes later it could only just be made out; this may have been due to thin cirrus drifting below the sheet that caused the halo. During the phenomena, and for some time previously, a quantity of rippled cirrus drifted from the north.

C. J. P. CAVE.

Stoner Hill, Petersfield. February 24th, 1931.

Summer Thunderstorms.

It is proposed to commence the census of the thunderstorms occurring in the six summer months of each year, for this purpose called "Summer Thunderstorms," on April 1st, 1931. The records will form a sequel to the winter investigation which was originated by Mr. C. J. P. Cave, carried on over a number of years, and finally concluded in March, 1929. It is probable that the new census will extend over the summers of 1931 to 1936, in order that sufficient data may be available for comparison with the winter material already obtained.

Details of Observations.—The main details required are the place, date and time of the occurrence, between April 1st and September 30th, of thunder, lightning or hail, with the direction in which the lightning was seen, especially at night.

It is essential that the position from which the observation is made should be specified by mentioning the approximate distance and direction from a railway station or other point which may be identified on a large scale map. Please state whether the times are those shown by Public Clocks or Greenwich Mean Time.

In the case of actual thunderstorms additional information, for which the following are suggestions, will be welcome:—

1. Time of first observation of thunder or lightning, with direction and estimated distance.
2. Time of commencement of very heavy rain or hail, *or* approximate time of nearest approach of storm, with direction and estimated distance.
3. Approximate time of final observation of thunder or lightning, with direction.
4. Severity of storm; changes in direction or strength of wind, changes in temperature, etc., during the storm.

The shortest note for any of the days is valuable; it is not anticipated that every observer will fully record each storm.

Records should be sent on postcards to the undersigned at Langley Terrace, Oakes, Huddersfield, and not to the Meteorological Office.

S. MORRIS BOWER

NOTES AND QUERIES

The Influence of Forests on Climate in Kenya and Uganda

In discussing the question whether afforestation can increase the rainfall of any region, although it is possible to lay down certain general principles of theory, the various factors are so nicely balanced that local conditions may easily turn the scale in one direction or the other. This seems to be especially true in the tropics, and two papers* by J. W. Nicholson, Forest Adviser to the Governments of Kenya and Uganda, are therefore welcome contributions to the subject. One of the difficulties with which Mr. Nicholson had to contend was the inadequacy of the meteorological records for the districts about which he writes, hence his opinions can rarely be supported by statistical data. With his remarks about "miscellaneous influences," however, few will disagree. He believes that in the tropics forests have, compared with open land, lower mean temperature, smaller annual and diurnal ranges, a much smaller range of soil temperature and a higher relative humidity. It is with the influence of forests on rainfall that he enters the real controversy.

The first important local condition is that Kenya and Uganda almost fall into the category of enclosed basins, for only about a tenth of the rain finds its way into the Nile or the Indian Ocean. The remaining nine-tenths must ultimately be re-evaporated or transpired. Moreover, the relief of the country is such that oceanic air cannot readily penetrate into some parts, in which the rainfall must be derived almost entirely from land sources. Hence the importance of such sources is much greater than in countries open to oceanic winds. The second condition is that rains alternate with periods of drought. The author states that "there is not the slightest doubt but that in East Africa trees and deep-rooted shrubs give off far more moisture than herbaceous vegetation as during seasonal periods of drought the latter is not transpiring." He also supposes that forest transpiration exceeds evaporation from bare soil, though admittedly without any evidence. The excess of water given off by forests enables the moisture brought by oceanic winds to penetrate further inland than it would otherwise do, and therefore greatly increases the rainfall of the inland districts at the expense of the coastal rivers. Later, he somewhat neutralises this argument by pointing out the value of trees as wind-breaks to lessen the evaporation from the soil and crops which they shelter, and it seems very doubtful whether the transpiration from trees can be so excessive that partial

* Kenya, Forest Department Pamphlet No. 2. The influence of forests on climate and water supply in Kenya. By J. W. Nicholson. With a foreword by A. Walter; Entebbe 1930, and

Supplement to the above: Note on the influence of forests on climate and water supply in Uganda.

afforestation would make any appreciable difference to the rainfall to leeward.

That sums up one side of the author's case, namely, that forests give back to the air more moisture than any other form of surface. The other side is that forests also take from the air more moisture than crops or bare ground. The types of rainfall which he believes to be affected are "occult precipitation" or deposit of mosture from fog or dew, and instability rain. With regard to occult precipitation he writes: "Phillips' investigations at the South African Forest Research Station have shown that occult precipitation can amount to at least 25 per cent. of the annual rainfall." This somewhat vaguely worded quantitative estimate he adopts as valid for Kenya. The Wheel Wagon Gap experiment,* however, which is by far the most definite ever made in this connexion, entirely rules out any such figure, although the site would appear to have been especially favourable for its occurrence. The only alternative to supposing that occult precipitation is negligible is that it is given back to the air on the spot, within a few hours of its receipt, in which case it can equally well be left out of the discussion.

Finally, the author believes that forests materially increase the amount of instability rain. His theoretical argument is that air over forests is moister than that over dry ground; he admits that the air over the latter becomes very much hotter than the forest air but considers that it is too dry to give rain. The relative humidity of forest air is admittedly greater than that of air over neighbouring bare or cultivated ground, simply because the former is the cooler, but apart from the assumed greater transpiration there is no evidence that the amount of moisture is greater. For convective purposes bare ground is surely the most favourable, and forest the least favourable type of uniform surface, though probably a mixture of types is the most favourable of all.

The practical evidence for the most part reduces to the old argument that because more rain falls on forested than on unforested ground, therefore the forests induce the additional rainfall. This is not necessarily a fallacy, provided that all other factors are similar in the two areas, but it is very difficult to prove that the latter condition is fulfilled. The strongest example quoted is the Karamoja Plateau in Uganda, where the rainfall increases rapidly across the boundary between cropland and forest, although the topography gives no obvious reason for such a change.

The author remarks that the influence of forests on instability

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* Washington, D.C. U.S. Weather Bureau. Monthly Weather Review Suppl. No. 30, 1928. Forest and stream-flow experiment at Wagon Wheel Gap, Colo. Final report.

rain is probably very local, so that extensive forest tracts are not as valuable as smaller and more numerous forest tracts, and he recommends blocks of 4,000 acres or so in extent. This advice is probably good, for several reasons. In the first place, it is obviously no advantage for farmers to plant forests to increase transpiration and rainfall if all the increase falls back on the forest itself. The proportion which misses the forest and falls on the crops will be greater, the smaller the forest block. Secondly, the effectiveness of forests is presumably due in part to the differential heating of forested and unforested ground, and this effect would be lost if the forest areas were too large. Thirdly, as the author points out, the value of forests as wind-breaks depends on their periphery and not on their area, so that a square block may be no more effective than a long narrow strip of half the area.

As previously stated, the investigation was greatly handicapped by the absence of adequate meteorological and especially agricultural-meteorological data for East Africa, a defect which we can confidently expect the new British East African Service to supply. In fact Mr. A. Walter, the Director of that service, writes in his foreword to the Kenya paper that " steps are being taken to inaugurate an efficient Service of Stations throughout East African Territories with special reference to the elucidation of some of the problems which have been raised in this pamphlet." The collection of adequate quantitative data combined with experiments under proper control is the only way of arriving at a sure solution of the problems raised, but meanwhile the opinions of scientific officers such as Mr. Nicholson concerned with these problems, based on close personal observation over a wide area, are entitled to the fullest consideration.

C. E. P. Brooks.

The Deepening of Depressions by Day and Night

Two recent occasions when depressions off west Ireland deepened greatly during the night, after showing no great activity up to 6 p.m., and the memory of other cases in the past, raised the question as to whether depressions deepen more readily by night than by day. To test this point the charts for the winter half-year (October to March) were examined for the period from January, 1922, to December, 1930, and cases when depressions or secondaries deepened by 10mb. or more at the centre in 12 hours were noted. The area covered was between latitudes 40° and 60° N., and longitudes 30° W. and 10° E., excluding the Mediterranean. The majority of examples occurred to west or south-west of the British Isles and there were none on the continent. Obviously only those cases when sufficient ships' observations were available could be considered. The day and night

periods were equalised by interpolating the probable pressure at the centres of the depressions at 6 a.m. The rare cases when a deepening of 20mb. or more took place were also noted, and form the second group given below. The examples in the second group are also included in the first group:—

	Number of cases where depressions deepened by	
	10mb. or more	*20mb. or more*
Day period, 12 hours from 6 am. ...	28	3
Night period, 12 hours from 6 p.m. ...	50	8

In view of the absence of a close network of ships' observations, and the unavoidable necessity of some interpolation, the figures should be treated with great caution, but in all probability they imply something real. A number of marginal cases were rejected, and also all cases when there might have been a rapid movement from west rather than a development, and a considerable majority of the rejected cases were at night. The relation showed up in some winters much better than in others, and did not show at all during the very stormy winter of 1929-30. A small influence would show up best in a period when other factors were nearly balanced, rather than during an exceptionally unstable period. A complete statistical investigation of the deepening of Atlantic depressions is impossible with present data.

It has been pointed out by Prof. W. J. Humphreys* (quoting Mr. C. L. Mitchell of the U.S. Weather Bureau) that in the United States, depressions also deepen more by night than by day. The explanation given was that nocturnal radiation from the ground in the clear parts of a depression increases the horizontal temperature gradient, and also decreases surface frictional resistance. Neither part of this explanation can hold over the open sea. It is stated by Hann and Süring† that precipitation over the open sea has a maximum about midnight and a minimum at noon, though they do not give the data on which the statement is based. They publish hourly values of the rate of rainfall for the average of six coast stations throughout the year, showing a maximum in the early morning and a minimum in the afternoon, the ratio of the maximum to the minimum being 100 to 76. Conditions on the coast and over the open sea are, however, quite different.

The fact that depressions deepen more readily at night over both sea and land suggests that the true cause is in the upper air, not at the surface. Quite apart from this, it is now certain that the development of depressions cannot be interpreted entirely in terms of horizontal temperature differences. In the very stormy December of 1929 the mean temperature difference between Iceland and the Azores was below the normal for December. On

* *Washington, U.S. Dept. Agric., Monthly Weath. Rev.* 55, 1927, p. 496.
† Lehrbuch der Meteorologie, Leipzig, 1926, p. 349.

the other hand the lapse rate of temperature over the British Isles was considerably above the December normal, as shown by aeroplane ascents at Duxford and by frequent thunderstorms in various districts. C. K. M. DOUGLAS.

Gliding and Soaring Flight

A lecture on "the Meteorological Aspects of Gliding and Soaring Flight" was given by Mr. F. Entwistle, Superintendent of the Aviation Division of the Meteorological Office, before the Royal Aeronautical Society, on Thursday, February 26th. Colonel the Master of Sempill was in the chair, and was supported by Mr. E. C. Gordon England, Chairman of the British Gliding Association.

Mr. Entwistle, after enunciating the conditions for gliding and soaring flight, gave an account of the disturbances in the atmosphere which may produce a vertical component in the motion of the air, ranging from the small-scale turbulence, due to friction between the moving air and the ground, to the large ascending currents associated with line squalls and thunderstorms. Some examples of the magnitudes of extreme vertical currents deduced from measurements of the dimensions of hailstones and from air pilots' personal experiences were given. The latter part of the lecture was devoted to the application of the knowledge of wind structure to gliding and soaring flight and to a discussion of the possible use of sailplanes in obtaining more detailed meteorological data.

The discussion which followed the lecture was opened by Sir Gilbert Walker, who dealt more particularly with the phenomenon of "dynamic" soaring in which use is made of temporary fluctuations in a turbulent wind. He was followed by Dr. G. C. Simpson and Mr. Gordon England. Other speakers included Captain Latimer Needham, Dr. Thurston, Dr. F. J. W. Whipple, and Mr. Manning.

Unusual Lightning Phenomena

Mr. E. Kidson, Director of the Meteorological Office, Wellington, N.Z., has sent the following extract from the *Marlborough Express*, Blenheim, November 10th, 1930. The thunderstorm occurred in connexion with a line-squall accompanying the trough of a very rapidly moving inverted V-depression :—

"During the height of an electrical storm which burst over the Wairau Plain on Saturday afternoon (November 8th), the residence of Mr. C. E. Matthews, at Rapaura, was struck by lightning, which caused considerable damage, though very fortunately none of the occupants of the house were injured. The building,

though enveloped for a considerable time in a thick cloud of smoke, did not catch fire.

Mrs. Matthews was in town at the time, and Mr. Matthews was attending to his duties on the farm. Those in the house were their little daughters, June and Barbara, their infant son Peter and Miss P. Reeves. The little boy was asleep in his cot, but the girls and Miss Reeves were in the kitchen when the lightning struck a corner of the room, partly wrecking one wall and hurling a fair-sized piece of timber right across the kitchen and through an open door into an adjoining room. How it missed the three girls is beyond explanation.

A series of sharp little explosions followed the major crash which signalised the wrecking of the wall, and the terror of the occasion was added to by the crash of falling glass, as windows in various parts of the house were blown out by the shock of the explosions. The building was immediately filled with thick acrid smoke, through which the occupants were terrified to observe the pale flicker of a blue electric flame which enveloped the whole building. Miss Reeves lost no time in snatching up the sleeping infant and in herding her little charges outside, where, in the pelting rain which followed the discharge, they witnessed an awe-inspiring sight, the whole house being wrapped in blue flickering flame for an appreciable period.

Subsequent investigations seem to establish the fact that the lightning struck a wireless aerial entering the house near its south-eastern corner. Fortunately, Mr. Matthews had "earthed" the aerial when the storm threatened, but the earth wire passed close to one of the pipes of an Aerogen gas plant with which the building is equipped, and it is evident that the current travelled along the gas pipes to various parts of the house, causing damage in all sorts of unexpected places. The wireless aerial had vanished as if it had never existed, being completely burned up by the terrific voltage which it was called on to carry and leaving only the blackened and cracked insulators between which it had been strung. Nearer the wireless set, where the wires were of the insulated variety, the wire core had been completely burned out, leaving the torn insulation like an empty stocking.

The major damage consists of half-a-dozen weather boards wrenched off the outer wall with such force that one of them was flung over an adjacent fence. The interior lining boards were also blown off, a piece of one of them travelling right across the kitchen, as has already been reported. In one of the upstairs rooms a hole was torn in the floor and there are two small holes right through the outer wall, while altogether nine window panes were blown out.

That the lightning struck in more than one place is demonstrated by the fact that two fairly long sections of heavy wire in

a fence close to the house were burned right away and a fencing post some distance away was split, while a telephone pole at least 200 yards away from the house was also wrecked.

Several residents in the locality report that their telephone fuses were blown out, with such force, in some cases, that they were hurled to a considerable distance.

Mr. Matthews, who was attending to the housing of some fowls at the time, had an alarming experience. He states that at the height of the storm he felt as if he had been struck a sudden and heavy blow behind the knees. It sent him headlong and he was surprised to find that he was still alive, and still more surprised to discover that he was unhurt. One of the fowls became wrapped in blue flame and was "knocked out," but it subsequently recovered and is apparently none the worse. Mr. Matthews lost no time in rushing to the house, which he observed to be wrapped in smoke, and he was greatly relieved to find his family and Miss Reeves safe.

The smoke clung about the building so thickly and for such a lengthy period that it attracted the attention of neighbours, who thought the house was on fire.

A young man working on the farm also had an alarming experience when his three horses became enveloped in the mysterious blue flame. He succeeded in releasing them without trouble. In other places, it is reported, settlers felt the effect of the discharge, one man having a hammer knocked out of his hand, while several report feeling the mysterious pressure behind the knees which was experienced by Mr. Matthews.

Heavy rain near Whitby, August 20th-23rd, 1930

According to a report in *The Times* of August 24th, 1930, the Whitby lifeboat was used for rescue work at Ruswarp, two miles inland, in floods occasioned by the heavy rains of August 20th to 23rd. This incident was referred to in an article on page 159 of the *Meteorological Magazine* for August, 1930, and again on page 291 of the January, 1931, number. We have now received from R. H. Rastall, Esq., of Turnerdale Hall, Whitby, a letter from which the following is an extract :—

"What really happened was that the very small and flimsy pleasure boats of the present day were found inadequate to remove the inhabitants of certain cottages, as has been done many times in the past with the heavier boats of those days, so some fishermen and, I believe, one or two coast-guardsmen brought a heavier boat by road from Whitby on a lorry.

"I have often seen such 'rescues' in the past, especially at the end of the wet decade 1871-80—I have a vivid recollection of watching a suspension bridge floating down the river on Octo-

ber 28th, 1880, when I was eight years old, and there are records of tremendous floods of the same type in 1866 and 1840. I may say that a large part of the scene of the supposed liftboat episode is my property, and some of my land at Grosmont also suffered considerably. It is well authenticated that at one point on my land about 2 miles below Grosmont the river rose 30ft., but I think that was largely due to the blocking of a railway bridge by floating trees."

Books Received

Meteorological Normals of Calcutta. By V. V. Sohoni (Journal and Proceedings, Asiatic Society of Bengal, New Series, XXV, 1929, No. 1) containing tables and diagrams of normals of pressure, temperature, humidity, rainfall, cloud, sunshine and surface and upper winds mostly for the period 1901-20, together with notes of the instruments and methods of observation.

Jaarboek, Koninklijk Nederlandsch Meteorologisch Instituut 1928. A. Meteorologie, B. Aard-Magnetisme (Nos. 97 and 98), Utrecht, 1929.

Ergebnisse Aerologischer Beobachtungen, 1928. K. Ned. Meteor. Inst. (No. 106A). Utrecht, 1929.

Helligkeitsverteilung über den Himmel im Ultraviolett. By C. Dorno and F. Lindholm (Met. Zs., 1929, pp. 281-292).

Obituary

Mr. Henry Harries.—Mr. Harries whose death in his eightieth year was announced in our last issue, entered the office as a boy clerk in 1875. Up to the year 1903 he served continuously in the Marine Division, where he developed a keen interest in the problems of marine meteorology. His enthusiasm for his work led him to spend many of his holidays at sea in ships big and little, and he thus acquired a practical familiarity with the special difficulties of observing at sea which is given to few landsmen. The knowledge which he gained of the ways of seamen stood him in good stead late in his career when he was called upon to take charge of the Marine Division upon the death of the Marine Superintendent, Captain Campbell Hepworth, early in 1919, pending the appointment of a new Superintendent. It was a time of great stress and difficulty, for the work of observing at sea had been sadly disorganised by the war, and Harries rendered conspicuous service in getting it re-started.

From 1903 to 1919 Harries was attached to the Forecast Division as one of those responsible for the issue of forecasts and gale warnings. Here, again, his knowledge of marine meteorology proved a great asset, for into this period fell the early application of wireless telegraphy in the forecast service

in an attempt to collect observations from ships in the North Atlantic and combine them with those from the land stations.

Most of the papers which Harries contributed dealt with the meteorology of the sea. As a disciple of Buchan he held strongly that many of the depressions that visit our islands originate in tropical hurricanes, and he succeeded on one occasion in tracing a storm all the way from the Philippines to Scandinavia, a task which involved no small amount of patient investigation when one bears in mind how scanty and scattered was the material for such investigations in 1882. He was also responsible for papers on the frequency of hail at sea, and for a collection of data regarding the occurrence of hail and thunderstorms in the Arctic regions. Another subject which interested him greatly was the possible connexion between colliery explosions and meteorological phenomena. He assiduously collected data on the subject, and held firmly that periods of high barometer pressure were favourable for the development of dangerous conditions in coalmines.

In 1912, when on one of his many foreign holidays, Harries was granted facilities for a series of experiments with no-lift balloons on the eddy winds around the Rock of Gibraltar. Attention had been directed to the matter by the peculiar character during east winds of the records of the Dines pressure tube anemometer, which had been established on the Rock a few years earlier. The results of this, perhaps the earliest experimental investigation of cliff eddies, are set out in a paper read before the Royal Meteorological Society in 1914.

Harries retired from the Office at the end of March, 1920, his period of service having extended over no less than 45 years. He is remembered by those who served under him as juniors as a strict disciplinarian, an excellent teacher, and as one who had an almost uncanny aptitude for spotting errors in a table of figures! For many years he acted as meteorological correspondent to the *Morning Post*. He was a Fellow of the Royal Meteorological Society from 1887 to 1914.

R. G. K. Lempfert.

Mr. Arthur Waters Preston.—We learn with deep regret of the death of Mr. Preston on March 1st, 1931. Mr. Preston rendered many services to the science of meteorology. He started a climatological station at Eaton (Norwich) on October 1st, 1905, and forwarded returns regularly to the Meteorological Office. His observations extend back to 1883 and were made at Thorpe Hamlet, Blofield and Brundall prior to those at Eaton. Mr. Preston was also Secretary of the Norfolk Rainfall Organisation, and collected rainfall records from the district each month for publication in the local press and for subsequent inclusion in *British Rainfall* It is hoped that arrangements can be made for the valuable climatological observations to be uninterrupted and for the Norfolk Rainfall Organisation to continue its useful work.

News in Brief

According to the *Cornish Times*, during the height of a severe thunderstorm at Bolventor, Cornwall, about the 12th, a "ball of flaming fire" swept through the village very early in the morning leaving large pits in the road, killing two pigs and four cows, making a large hole in a granite wall and wrenching the guttering and water-pipes from the school.

Mr. J. Crichton, Assistant Superintendent in the Meteorological Office, has been elected a Fellow of the Royal Society of Edinburgh.

The 12th Annual Soirée of the staff of the Meteorological Office was held at the Portman Rooms, on Friday, February 6th, 1931. The Soirée, which consisted of dancing with two intervals during which "The Benthams" Concert Party entertained, was both a social and financial success. Mr. A. E. Pycock, who is retiring from the office staff at the end of March, sang two humorous songs, which were greatly appreciated.

The Tenth Annual Dinner of the Staff of the Meteorological Office, Shoeburyness was held at the Queen's Hotel, Westcliff, on February 7th. Amongst those present were several past members of the staff now serving at other stations. Mr. D. Brunt, the Superintendent for the Army Service Division, was present as the guest of the staff. In view of the anniversary nature of the occasion, a special souvenir menu was printed in which appeared a brief account of the early history of the station.

On Wednesday, February 25th, a team representing the Meteorological Office defeated, by 6 goals to 0, a team representing the Directorate of Equipment in the final round for the Air Ministry Football Cup. At the close of the match Mr. R. C. Richards presented the Cup to the Meteorological Office team on behalf of the Air Ministry. This is the third successive year and the fourth time in all that the Office has won this trophy.

The Abnormal Weather of Europe during February, 1931.

The distribution of pressure was highly abnormal. A sketch map of the deviations of pressure from normal, drawn from a skeleton distribution of stations, is shown in figure 1. The main features are four: an area with pressure more than 10mb. above normal, including the Azores and central North Atlantic; an area more than 15mb. above normal over western Siberia, the excess reaching 19·4mb. at Sverdlovsk; and areas more than 10mb. below normal near Spitsbergen and over Alaska. The distribution was especially interesting in the North Atlantic and north-west Europe. The Azores anticyclone was of abnormal

intensity and displaced to the north of its normal position, while the Icelandic low took the form of a deep trough running north and south from Spitsbergen to the Shetlands. To the west of this trough there were unusually frequent and strong northerly winds, especially over Iceland, where the temperature was 8°F. below the normal for the month. To the east of the trough, on the other hand, Spitsbergen experienced strong southerly winds, heavy snow and unusual warmth, the average temperature being no less than 23°F. above normal. Further south the winds

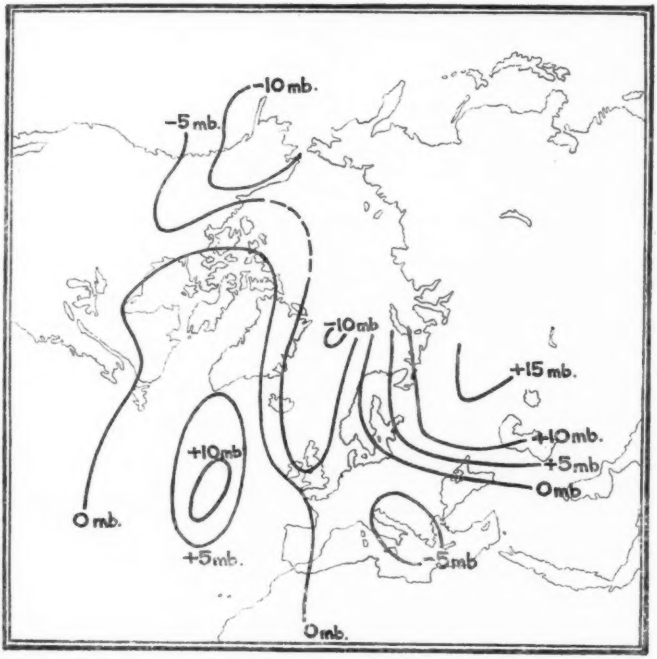

FIG. 1. DEVIATIONS OF PRESSURE FROM NORMAL, FEBRUARY, 1931.

became more south-easterly, owing to the influence of the Siberian anticyclone, and in Scandinavia temperature was only slightly above normal, though there was heavy rain and snow.

In central Europe conditions were more complex, currents of Mediterranean air meeting air from eastern Europe and Siberia. Under these conditions heavy snow was general, especially after the 11th, and extended even to northern Italy and northern Spain, while temperature was rather low. According to *The Times* snow fell in Venice for the first time for many years, while owing to the tremendous snowfalls and drifts caused by

violent winds several Alpine regions, including Zermatt, were cut off from the outside world about the 24th. Avalanches were numerous, and many disasters occurred in Switzerland and northern Spain.

The Weather of February, 1931

Squally westerly or north-westerly winds and frequent wintry precipitation were the chief features of the weather of the British Isles during February. A depression passed across the country on the first of the month and gales were experienced generally, Beaufort force 9 occurring at many places in the north and west. By the 3rd conditions had changed, a ridge of high pressure extended across the country, and quiet, cold weather prevailed with a varying amount of sun. Maximum temperatures did not exceed 33°F. at Marchmont on the 4th, and at Durham, Rothamsted and Harrogate on the 5th. Snow occurred generally from the 1st to 7th, slight in the south but lying to some depth in the north; $4\frac{3}{4}$in. were measured at Harrogate on the 7th. On the 7th a deep depression approached from the Atlantic and the weather became mild and unsettled, with westerly winds by the 8th. Temperature rose generally above 50°F., and reached 56°F. at Dublin and 55°F. at Ross-on-Wye on the 9th. Heavy rain occurred in west Ireland on the 7th, and over the country generally on the 9th and 11th, 2·30in. being measured at Llyn Fawr, Glamorgan, on the 9th, and 1·55in. at Oughtershaw, Yorkshire, on the 11th. In the rear of this depression there were strong north-westerly winds reaching gale force at times on the 11th, 12th and 13th, which caused a considerable drop in temperature. Precipitation again took the form of hail, sleet or snow in the north and west, but did not lie to any depth. From the 13th-24th depressions passed across the country and cold weather with squally north-westerly winds, and rain, sleet or snow at times persisted with short breaks. Slight snow occurred even as far south as Margate, Southampton and Bath, and lay to a depth of 5in. at Armagh on the 24th, and of 3in. at Rothesay on the 22nd. Gales were again experienced on the 16th and 17th. The 14th, 21st and 22nd were markedly sunny days, over 8 hrs. bright sunshine being recorded at several places, and 9·4 hrs. at Plymouth on the 21st. On the 24th, the anticyclone over the Bay of Biscay spread northwards, south-westerly winds were general by the 25th, and temperature rose high for the time of year reaching 59°F. at Aberdeen and 58°F. at Cambridge, Waterford and Hull on the 25th. On the 26th, the winds veered north-west and another cold spell ensued, maximum temperature not rising above 32°F. locally in the English Midlands on the 28th. Gales occurred in the north and west in the 28th, and in the evening snow fell generally over the whole country. Thunder and lightning were observed locally in

the south and west on the 12th, 20th, 21st and 28th. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	64	+ 6	Liverpool	63	— 5
Aberdeen	82	+ 9	Ross-on-Wye	77	+ 6
Dublin	70	— 3	Falmouth	80	— 3
Birr Castle	62	— 5	Gorleston	41	—40
Valentia	59	— 10	Kew	60	0

In Sweden pressure was generally normal, but 3mb. below in the south and 3mb. above in the north-east. Temperature was likewise normal but for a band over central Norrland, where it was nearly 4°F. below. Rainfall was very irregular, but in the mean only slightly below normal. In Jaemtland, western Lapland and Vestrogothia there was only half the normal rainfall, but in Scania, Waermland, Dalecarlia and Vesterbotten, the excess was more than 50 per cent.

Miscellaneous notes on weather abroad culled from various sources

Severe drought was experienced in southern Spain during the month. A storm of great violence broke over the Mediterranean and southern Italy on the 22nd, the centre being over the province of Palermo, where much damage was done. (*The Times*, Feb. 24th, 1931.)

Unusually heavy rains in the south-eastern districts of Queensland caused the worst floods for some years in several coastal towns, but the rains in the upper reaches of the Brisbane river ceased in time to avert the danger of a serious flood in Brisbane, though the low-lying parts of the city were flooded. Heavy rain was also experienced in the north-east of New South Wales. (*The Times*, Feb. 6th-7th, 1931.)

The north and west of the main island of Viti Levu, Fiji Islands, where are situated the chief sugar-growing areas of Fiji, was struck by a hurricane on the 21st and 22nd. Much damage was done, the worst effect being the unprecedented floods; over 100 people lost their lives. (*The Times*, Feb. 27th-28th, 1931.)

Except for the extreme north-east temperature was generally abnormally high in the United States during the first part of the month, while rainfall was about normal. (*Washington, U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Rainfall, February, 1931—General Distribution

England and Wales ...	124	per cent of the average 1881-1915.
Scotland	118	
Ireland	104	
British Isles	118	

Rainfall: February, 1931: England and Wales

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square.........	1·83	110	*Rut* .	Ridlington...............	2·72	166
Sur .	Reigate, Alvington.....	2·22	101	*Linc* .	Boston, Skirbeck.......	2·53	173
Kent .	Tenterden, Ashenden...	2·65	134	,, .	Cranwell Aerodrome...	2·72	158
,, .	Folkestone, Boro. San..	2·50	...	,, .	Skegness, Marine Gdns	1·69	110
,, .	Margate, Cliftonville...	1·88	136	,, .	Louth, Westgate........	2·32	121
,, .	Sevenoaks, Speldhurst	2·27	...	,, .	Brigg, Wrawby St......	2·44	...
Sus .	Patching Farm.........	2·24	101	*Notts* .	Worksop, Hodsock.....	2·35	153
,, .	Brighton, Old Steyne..	1·64	81	*Derby* .	Derby, L. M. & S. Rly.	2·72	168
,, .	Heathfield, Barklye....	2·71	115	,, .	Buxton, Devon Hos....	5·19	138
Hants .	Ventnor, Roy. Nat. Hos.	2·42	115	*Ches* .	Runcorn, Weston Pt...	2·77	149
,, .	Fordingbridge, Oaklnds	2·38	95	,, .	Nantwich, Dorfold Hall	2·98	...
,, .	Ovington Rectory.......	2·05	79	*Lancs* .	Manchester, Whit. Pk.	3·82	199
,, .	Sherborne St. John.....	1·72	78	,, .	Stonyhurst College.....	6·16	184
Berks .	Wellington College.....	1·49	79	,, .	Southport, Hesketh Pk	2·79	133
,, .	Newbury, Greenham...	2·01	91	,, .	Lancaster, Strathspey	3·36	...
Herts .	Welwyn Garden City...	1·62	...	*Yorks* .	Wath-upon-Dearne.....	2·16	133
Bucks .	H. Wycombe, Flackwell	1·71	...	,, .	Bradford, Lister Pk....	3·62	155
Oxf . .	Oxford, Mag. College..	1·57	99	,, .	Oughtershaw Hall......	9·46	...
Nor .	Pitsford, Sedgebrook...	2·49	149	,, .	Wetherby, Ribston H.	2·11	122
,, .	Oundle..................	2·11	...	,, .	Hull, Pearson Park.....	2·40	145
Beds .	Woburn, Crawley Mill	1·70	115	,, .	Holme-on-Spalding.....	2·51	...
Cam .	Cambridge, Bot. Gdns.	1·63	127	,, .	West Witton, Ivy Ho.	2·92	102
Essex .	Chelmsford, County Lab	1·76	119	,, .	Felixkirk, Mt. St. John	1·72	102
,, .	Lexden Hill House....	2·17	...	,, .	Pickering, Hungate....	3·16	182
Suff .	Hawkedon Rectory.....	2·92	192	,, .	Scarborough..........	2·01	120
,, .	Haughley House........	2·23	...	,, .	Middlesbrough..........	1·16	89
Norf .	Norwich, Eaton...... ...	...	...	,, .	Baldersdale, Hury Res.	3·15	...
,, .	Wells, Holkham Hall	2·71	183	*Durh* .	Ushaw College..........	1·42	89
,, .	Little Dunham..........	3·04	187	*Nor* .	Newcastle, Town Moor	1·15	72
Wilts .	Devizes, Highclere......	2·25	113	,, .	Bellingham, Highgreen	2·51	99
,, .	Bishops Cannings.......	2·74	129	,, .	Lilburn Tower Gdns....	1·52	78
Dor .	Evershot, Melbury Ho.	2·88	92	*Cumb* .	Geltsdale.................	3·52	...
,, .	Creech Grange..........	1·92	67	,, .	Carlisle, Scaleby Hall	3·00	135
,, .	Shaftesbury, Abbey Ho.	2·44	105	,, .	Borrowdale, Seathwaite	13·75	116
Devon .	Plymouth, The Hoe...	3·23	109	,, .	Borrowdale, Rosthwaite	8·47	...
,, .	Polapit Tamar..........	3·56	111	,, .	Keswick, High Hill.....	3·85	...
,, .	Ashburton, Druid Ho.	...	...	*West* .	Appleby, Castle Bank..	2·98	101
,, .	Cullompton.......	3·12	112	*Glam* .	Cardiff, Ely P. Stn.....	3·23	108
,, .	Sidmouth, Sidmount...	2·40	96	,, .	Treherbert, Tynywaun	9·00	...
,, .	Filleigh, Castle Hill....	4·66	...	*Carm* .	Carmarthen Friary.....	4·84	131
,, .	Barnstable, N. Dev. Ath.	3·58	132	,, .	Llanwrda............	5·94	136
Corn .	Redruth, Trewirgie.....	3·52	93	*Pemb* .	Haverfordwest, School	4·90	141
,, .	Penzance, Morrab Gdn.	4·16	125	*Card* .	Aberystwyth............	4·22	...
,, .	St. Austell, Trevarna...	4·17	109	,, .	Cardigan, County Sch.	3·17	...
Soms .	Chewton Mendip........	3·62	107	*Brec* .	Crickhowell, Talymaes	4·40	...
,, .	Long Ashton............	2·27	97	*Rad* .	BirmW. W. Tyrmynydd	6·73	128
,, .	Street, Millfield	2·34	116	*Mont* .	Lake Vyrnwy...........	7·59	167
Glos. .	Cirencester, Gwynfa....	2·40	106	*Denb* .	Llangynhafal............	3·11	138
Here .	Ross, Birchlea...........	1·75	87	*Mer* .	Dolgelly, Bryntirion...	8·54	193
,, .	Ledbury, Underdown..	1·93	106	*Carn* .	Llandudno...............	2·69	129
Salop .	Church Stretton.........	2·28	104	,, .	Snowdon, L. Llydaw 9	16·70	...
,, .	Shifnal, Hatton Grange	2·11	130	*Ang* .	Holyhead, Salt Island	2·39	98
Worc .	Ombersley, Holt Lock	1·88	115	,, .	Lligwy....................	1·97	85
,, .	Blockley..................	2·73	...	*Isle of Man*			
War .	Birminghm, Edgbaston	2·47	146		Douglas, Boro' Cem....	3·61	113
Leics .	Thornton Reservoir....	3·31	199	*Guernsey*			
,, .	Belvoir Castle...........	2·45	147		St. PeterP't. GrangeRd.	3·47	141

Erratum for January. Carmarthen Friary for 3·77/86, read 4·62/105.

Rainfall: February, 1931: Scotland and Ireland

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Pt. William, Monreith	2·79	91	*Suth* .	Loch More, Achfary ...	12·05	183
,, .	New Luce School......	3·80	100	*Caith* .	Wick........................	2·88	127
Kirk .	Carsphairn, Shiel.......	7·61	116	*Ork* .	Pomona, Deerness......	4·33	144
Dumf.	Dumfries, Crichton, R.I	2·47	...	*Shet* .	Lerwick....................	7·12	225
,, .	Eskdalemuir Obs........	5·98	121	*Cork* .	Caheragh Rectory......	4·40	...
Roxb .	Branxholm	2·40	91	,, .	Dunmanway Rectory...	3·65	62
Selk .	Ettrick Manse............	4·61	100	,, .	Ballinacurra.............	2·61	70
Peeb .	West Linton.............	3·80	...	,, .	Glanmire, Lota Lo......	3·18	80
Berk .	Marchmont House.......	1·76	85	*Kerry*.	Valentia Obsy..........	5·09	98
Hadd.	North Berwick Res.....	1·71	110	,, .	Gearahameen............	8·30	...
Midl .	Edinburgh, Roy. Obs.	1·85	116	,, .	Killarney Asylum......	4·73	90
Lan .	Auchtyfardle.............	2·97	...	,, .	Darrynane Abbey.......	4·72	102
Ayr .	Kilmarnock, Agric. C.	3·78	132	*Wat* .	Waterford, Brook Lo...	2·16	66
,, .	Girvan, Pinmore..	4·74	111	*Tip* .	Nenagh, Cas. Lough...	4·26	136
Renf .	Glasgow, Queen's Pk. .	3·27	111	,, .	Roscrea, Timoney Park	1·46	...
,, .	Greenock, Prospect H.	6·09	108	,, .	Cashel, Ballinamona...	2·93	91
Bute .	Rothesay, Ardencraig.	6·59	165	*Lim* .	Foynes, Coolnanes......	3·48	109
,, .	Dougarie Lodge..........	3·99	...	,, .	Castleconnel Rec.......	4·12	...
Arg .	Ardgour House	12·20	...	*Clare* .	Inagh, Mount Callan...	7·25	...
,, .	Manse of Glenorchy...	9·08	...	,, .	Broadford, Hurdlest'n.	3·79	...
,, .	Oban........................	5·22	119	*Wexf*.	Gorey, Courtown Ho...	2·30	82
,, .	Poltalloch	6·40	148	*Kilk* .	Kilkenny Castle.........	2·02	80
,, .	Inveraray Castle...	9·57	141	*Wic* .	Rathnew, Clonmannon	1·79	...
,, .	Islay, Eallabus..........	6·94	165	*Carl* .	Hacketstown Rectory..	2·45	82
,, .	Mull, Benmore..........	...	...	*Leix* .	Blandsfort House......	2·37	88
,, .	Tiree	...	...	,, .	Mountmellick............	3·09	...
Kinr .	Loch Leven Sluice......	1·70	95	*Off'ly* .	Birr Castle..............	2·53	110
Perth .	Loch Dhu.................	7·05	95	*Kild'r*.	Monasterevin	2·31	...
,, .	Balquhidder, Stronvar	5·71	...	*Dubl* .	Dublin, FitzWm. Sq...	1·11	59
,, .	Crieff, Strathearn Hyd.	1·86	53	,, .	Balbriggan, Ardgillan.	1·85	94
,, .	Blair Castle Gardens...	2·63	94	*Me'th* .	Beauparc, St. Cloud...	2·19	...
Angus.	Kettins School.	1·16	55	,, .	Kells, Headfort..........	2·79	103
,, .	Dundee, E. Necropolis	1·35	72	*W.M.* .	Moate, Coolatore......	2·50	...
,, .	Pearsie House............	3·23	...	,, .	Mullingar, Belvedere..	3·01	108
,, .	Montrose, Sunnyside...	1·86	101	*Long* .	Castle Forbes Gdns......	3·24	114
Aber .	Braemar, Bank...	2·14	75	*Gal* .	Ballynahinch Castle...	7·98	156
,, .	Logie Coldstone Sch....	1·38	66	,, .	Galway, Grammar Sch.	3·64	...
,, .	Aberdeen, King's Coll.	2·80	136	*Mayo* .	Mallaranny...............	7·49	...
,, .	Fyvie Castle.............	3·33	149	,, .	Westport House.........	5·07	128
Moray.	Gordon Castle...........	2·41	125	,, .	Delphi Lodge............	9·80	114
,, .	Grantown-on-Spey......	2·11	100	*Sligo* .	Markree Obsy............	4·42	126
Nairn.	Nairn, Delnies	1·86	103	*Cav'n* .	Belturbet, Cloverhill...	2·96	113
Inv .	Kingussie, The Birches	2·67	...	*Ferm* .	Enniskillen, Portora...	3·52	...
,, .	Loch Quoich, Loan.....	11·75	...	*Arm* .	Armagh Obsy............	2·68	121
,, .	Glenquoich...............	10·96	106	*Down* .	Fofanny Reservoir......	5·52	...
,, .	Inverness, Culduthel R.	2·26	...	,, .	Seaforde..................	2·26	74
,, .	Arisaig, Faire-na-Squir	5·39	...	,, .	Donaghadee, C. Stn...	2·59	112
,, .	Fort William.............	7·33	...	,, .	Banbridge, Milltown...	2·09	...
,, .	Skye, Dunvegan.........	8·38	...	*Antr* .	Belfast, Cavehill Rd...	3·46	...
R & C.	Alness, Ardross Cas ...	4·37	132	,, .	Glenarm Castle.........	4·67	...
,, .	Ullapool	8·05	186	,, .	Ballymena, Harryville	4·47	138
,, .	Torridon, Bendamph...	7·87	100	*Lon* .	Londonderry, Creggan	5·41	170
,, .	Achnashellach............	7·79	...	*Tyr* .	Donaghmore.............	...	...
,, .	Stornoway................	6·97	...	,, .	Omagh, Edenfel.........	4·32	145
Suth .	Lairg.......................	5·40	181	*Don* .	Malin Head..............	4·18	..
,, .	Tongue.....................	4·65	134	,, .	Dunfanaghy..............	5·17	...
,, .	Melvich....................	4·63	...	,, .	Killybegs, Rockmount.	5·04	101

Climatological Table for the British Empire, September, 1930.

STATIONS	PRESSURE: Mean of Day M.S.L. (mb)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE: Absolute Max. (° F.)	TEMPERATURE: Absolute Min. (° F.)	TEMPERATURE: Mean Values Max. (° F.)	TEMPERATURE: Mean Values Min. (° F.)	TEMPERATURE: Mean Values ½ max. and min. (° F.)	TEMPERATURE: Mean Values Diff. from Normal (° F.)	TEMPERATURE: Mean Wet Bulb (° F.)	Relative Humidity (%)	Mean Cloud Am'nt (0—10)	PRECIPITATION: Am'nt (in.)	PRECIPITATION: Diff. from Normal (in.)	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
London, Kew Obsy.	1014·0	— 3·4	76	45	64·8	52·5	58·7	+ 1·6	53·4	91	7·7	2·53	+ 0·66	18	3·9	31
Gibraltar	1017·1	— 0·2	93	61	83·0	66·5	74·7	+ 2·2	65·2	82	4·6	0·04	— 1·35	1	..	..
Malta	1016·1	— 0·8	86	62	79·5	69·3	74·4	— 1·6	68·7	75	3·1	2·51	+ 1·24	3	9·9	80
St. Helena	1017·3	+ 1·2	61	51	58·4	53·2	55·8	— 2·1	53·9	96	9·9	1·89	— 1·13	19	..	..
Sierra Leone	1014·3	+ 2·1	86	69	82·5	71·2	76·9	— 2·2	74·9	89	8·1	28·30	— 0·18	28	..	..
Lagos, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1013·0	— 0·7	89	46	80·1	58·2	69·1	— 0·4	..	55	3·1	0·59	+ 0·25	2	..	..
Salisbury, Rhodesia	1012·5	— 0·6	91	35	80·5	52·7	66·6	+ 0·2	51·9	25	1·3	0·15	— 0·11	1	9·7	81
Cape Town	1020·0	+ 0·9	80	40	65·5	49·6	57·5	— 0·4	51·3	85	5·0	5·13	+ 2·89	14	..	..
Johannesburg	1016·5	— 1·4	81	28	70·7	46·7	58·7	— 0·7	44·8	36	1·6	0·00	— 0·96	0	10·3	87
Mauritius	1019·9	— 0·3	81	60	77·5	64·6	71·1	+ 1·0	66·7	67	6·9	1·94	+ 0·64	20	7·5	63
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	0·00	— 0·90	..	..	..
Calcutta, Alipore Obsy.	1004·8	+ 0·3	94	76	89·7	79·2	84·5	+ 1·5	79·6	89	7·4	7·02	— 2·85	15*	..	..
Bombay	1007·8	— 0·2	92	73	85·7	76·5	81·1	+ 0·3	77·2	89	7·8	43·85	+ 33·17	13*	..	..
Madras	1006·3	— 0·2	99	73	93·6	76·7	85·1	0·0	76·4	73	5·8	3·88	— 1·11	6*	..	..
Colombo, Ceylon	1011·0	+ 1·0	86	71	84·8	76·2	80·5	— 0·4	76·7	79	8·0	6·59	+ 0·37	21	6·7	55
Hongkong	1009·8	+ 1·4	89	73	83·7	76·4	80·1	— 0·9	75·4	90	7·8	28·25	+ 18·26	15	4·6	37
Sandakan	..	..	93	73	89·3	75·2	82·3	+ 0·6	76·9	78	..	13·90	+ 4·51	9	..	..
Sydney, N.S.W.	1017·0	+ 1·0	83	43	69·2	50·3	59·7	+ 0·5	53·5	59	4·0	0·19	— 2·70	7	8·6	72
Melbourne	1016·7	+ 0·9	79	37	64·0	45·7	54·9	+ 0·8	48·2	58	6·3	1·27	— 1·14	18	6·1	51
Adelaide	1018·6	+ 1·3	82	41	67·5	49·4	58·5	+ 1·4	52·2	63	6·4	2·56	+ 0·52	17	6·6	56
Perth, W. Australia	1017·8	— 0·1	82	44	67·5	51·7	59·6	+ 1·3	54·3	70	5·3	4·30	+ 0·90	14	7·6	64
Coolgardie	1017·6	+ 0·5	93	36	73·7	46·5	60·1	+ 1·5	51·0	43	2·3	0·23	— 0·38	2	..	..
Brisbane	1018·8	+ 1·5	85	48	76·1	54·4	65·3	0·0	58·3	58	2·7	0·95	— 1·10	3	9·0	76
Hobart, Tasmania	1009·0	— 1·7	71	37	58·6	44·0	51·3	+ 0·5	45·7	63	6·8	1·51	— 0·62	22	5·7	48
Wellington, N.Z.	1005·9	— 8·7	59	32	52·7	42·4	47·5	— 4·1	45·0	74	7·5	4·82	+ 0·85	19	4·2	36
Suva, Fiji	1013·6	— 0·7	80	58	75·1	65·6	70·3	— 4·2	66·1	76	7·7	7·53	+ 0·55	18	3·6	30
Apia, Samoa	1010·8	— 1·3	86	72	83·3	74·5	78·9	+ 0·7	76·1	77	5·9	3·60	— 1·52	11	6·8	57
Kingston, Jamaica	1012·4	+ 0·2	95	68	91·2	78·4	84·8	+ 3·3	72·3	77	4·9	1·04	— 2·99	8	7·5	61
Grenada, W.I.	1013·0	+ 1·3	90	70	87·0	73·9	80·5	+ 0·3	74·4	78	5·5	6·41	— 1·85	18	..	..
Toronto	1014·5	— 3·3	87	39	72·6	53·6	63·1	+ 3·9	55·1	79	4·1	2·83	— 0·35	8	6·7	54
Winnipeg	1011·9	— 2·9	85	26	65·2	44·5	54·9	+ 1·5	41·8	72	4·4	1·30	— 0·98	7	6·4	50
St. John, N.B.	1013·9	— 3·6	73	44	65·0	51·3	58·1	+ 2·2	53·7	79	6·0	1·47	— 2·27	14	6·0	48
Victoria, B.C.	1015·1	— 1·4	82	46	64·0	51·0	57·5	+ 1·9	54·1	84	4·9	1·04	— 0·97	7	6·9	55

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Winnipeg	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
St. John, N.B.	1013·9	— 3·6	73	44	65·0	51·3	58·1	+ 2·2	53·7	79	6·0	1·47	— 2·27	14	6·0	48
Victoria, B.C.	1015·1	— 1·4	82	46	64·0	51·0	57·5	+ 1·9	54·1	84	4·9	1·04	— 0·97	7	6·9	55